

# ***Nuurcala obesa* sp. n. (Blattida, Caloblattinidae) from the Lower Cretaceous Yixian Formation in Liaoning Province, China**

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## **Abstract**

*Nuurcala obesa* sp. n., in the cockroach family Caloblattinidae, is described from the Lower Cretaceous Yixian Formation (Liaoning Province, China) based on a combination of differential characters of fore- and hind wing venation, colouration and body structures. Systematically, *Nuurcala* (Vršanský, 2003), known from the Cretaceous sediments of Bon Tsagaan and Khurilt, Mongolia, is closely related to other genera of Caloblattinidae known from the Jurassic and Cretaceous localities in other parts of Asia.

## **Keywords**

Fossil cockroach, new species, Huangbanjigou, wing venation, colouration

## **Introduction**

Caloblattinidae, a large extinct family of cockroaches, was erected by Vršanský and An-sorge, it consists of over 50 genera comprising nearly 200 described species distributed in Argentina, Australia, Brazil, Burma, China, England, France, Germany, Greenland, Japan, Kazakhstan, Kirgizstan, Mongolia, Russia, Spain, Switzerland, and South Africa during Middle Triassic to Late Cretaceous (Vršanský 2000, 2008b). Up to now,

the Caloblattinidae is presently under review and a number of taxa (both genera and species) are still waiting reassessment (Vršanský 2007), most of them were transferred from the taxonomical “waste basket” of the family Mesoblattinidae (Vršanský 2000). Caloblattinids probably originated from Phylloblattidae in the Early Triassic, representing part of the cockroach lineage leading from the older ancestors toward living cockroach taxa (Vršanský et al. 2002, 2003b). This family is distinguished by its large body, fairly long ovipositors in females, and both wings with dark colouration and veins multiple-branched (Vršanský 2000). Amber specimens of caloblattinids are extraordinary rare probably due to their large size resulting in lower probability of amber inclusion (Vršanský 2009).

Caloblattinidae was the dominant family from Upper Jurassic in Karatau, South Kazakhstan (Vishniakova 1968, 1973). The Raphidiomimidae originated from the Caloblattinidae (which is presumed to be paraphyletic family with respect to Raphidiomimidae, Liberiblattinidae and some other extinct families) (Vršanský 2003a). Both Caloblattinidae and Raphidiomimidae share strong synapomorphies such as wide abdominal segments, long palps, elongated wings with apparent intercalaries, diagonal fold in the forewing, hind wing with many reticulations in CuA-CuP space, R with R1 and RS abundantly branched, M weakly branched, CuA secondarily branched (Liang et al. 2009). We have collected about 1500 fossil cockroaches in sediments of the Early Cretaceous of Yixian Formation, most of them belong to Blattulidae (Wang et al. 2007a, b). However, so far, only 2 species of Caloblattinidae have been described: *Rhipidoblattina laternoforma* (Lin, 1978), *Euryblattula beibiaoensis* (Wang, 1987). This indicates in the Early Cretaceous, Caloblattinidae were not dominant in the Yixian Formation.

The strata of the Yixian Formation represent mainly lacustrine sediments intercalated with volcanoclastics, which contains a large number of Jehol Biota fossils, such as well-preserved dinosaurs, primitive birds, early mammals, fishes, ostracods, plants and abundant insects (Sun et al. 1998, Hou et al. 1999, Ding et al. 2001, Ren et al. 2010). Palaeobotanical data, including spores, pollen and plants described, indicate warm and moist climate (Ding et al. 2001). Zhang et al. (2004) and Xing et al. (2005) respectively base on isotope data and abundant statistical analysis of fossils data, coming to the consistent opinion that the age of Yixian Formation is determined as Early Cretaceous. And this opinion has been accepted widely (Swisher et al. 1999, Lu 2000, Zhou et al. 2003, Franz et al. 2007). Here we consider the age of Yixian Formation as the Early Cretaceous (about 125 Ma).

## Material and methods

The four specimens were collected from the Yixian Formation, Huangbanjigou, Chaomidian Village, Beipiao City, Liaoning Province, China. All type specimens are deposited in the fossil insect collection of the Key Laboratory of Insect Evolution & Environmental Changes, Capital Normal University, Beijing, China. They were examined with a Leica MZ 12.5 dissecting microscope and illustrated with the aid of a drawing

tube attached to the microscope. Line drawings were made with Photoshop CS 3.0 graphic software. Photographs of fossils were taken by a MZ12.5 dissecting microscope (Leica, Wetzlar, Germany), either dry or with alcohol.

The venation nomenclature used in this paper is based on the interpretation of Comstock and Needham (1898), followed also by Vishniakova (1964) and Vršanský (1997 and later). Abbreviations used: RFW- Right forewing; LFW- Left forewing; HW- Hind wing; Sc- Subcosta; R- Radius; Rs- Radius Sector; M- Media; Cu-Cubitus (A- anterior, P- posterior); A- Anal veins; Ant- Antenna. PIN – Paleontological Institute, Russian Academy of Sciences, Moscow, Russia. CNU – Capital Normal University, Beijing. PCMAS – Paleontological Center of Mongolian Academy of Sciences.

## Systematic palaeontology

**Order Blattida Latreille, 1810 (= Blattaria Latreille, 1810; = Blattodea Brunner von Wattenwyl, 1882)**

**Superfamily Caloblattinoidea Vršanský & Ansorge, 2000**

**Family Caloblattinidae Vršanský & Ansorge, 2000**

**Genus *Nuurcala* Vršanský, 2003**

<http://species-id.net/wiki/Nuurcala>

**Type species.** *Nuurcala popovi* Vršanský, 2003

### Composition.

*Nuurcala popovi* Vršanský, 2003. Bon Tsagaan Nuur, Bed 87/8, Mongolia; Barremian or Aptian, Early Cretaceous.

*Nuurcala srneci* Vršanský, 2008. Khurilt, Bed 210/24, Mongolia, Barremian or Aptian, Early Cretaceous.

*Nuurcala* sp. (collected by expedition of PIN led by M.B. Mostovski and P. Vršanský) Baissa, Transbaikalian Russia, ?Valanginian, Early Cretaceous.

*Nuurcala* sp. (collected by D. Davaadorj, deposited in the PCMAS, undescribed) Erdenyi Ula, Mongolia, Early Cretaceous.

**Stratigraphic and paleogeographic range of the genus.** ?uppermost Jurassic; Lower - Upper Cretaceous; Asia.

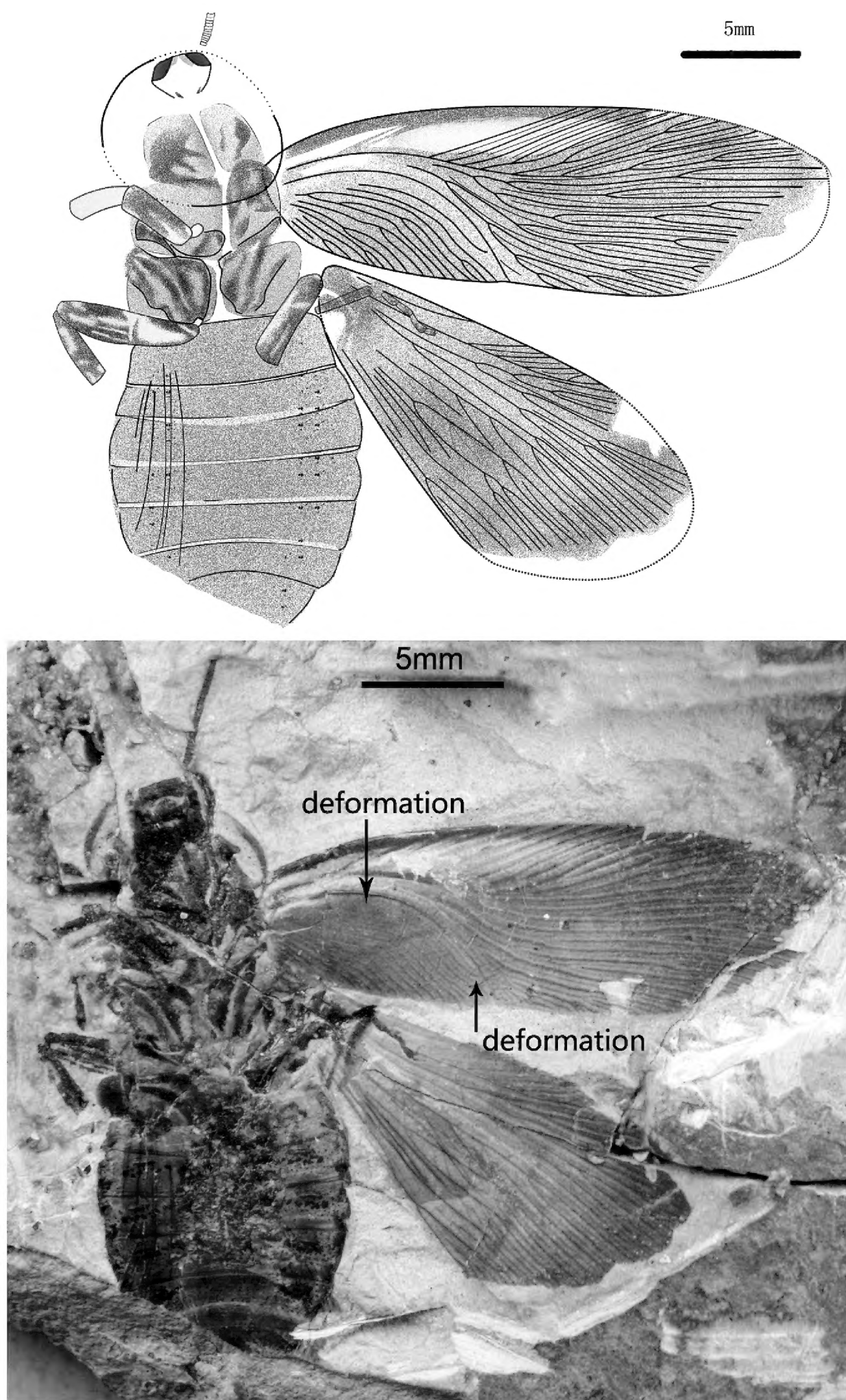
***Nuurcala obesa* Wang & Ren, sp. n.**

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[http://species-id.net/wiki/Nuurcala\\_obesa](http://species-id.net/wiki/Nuurcala_obesa)

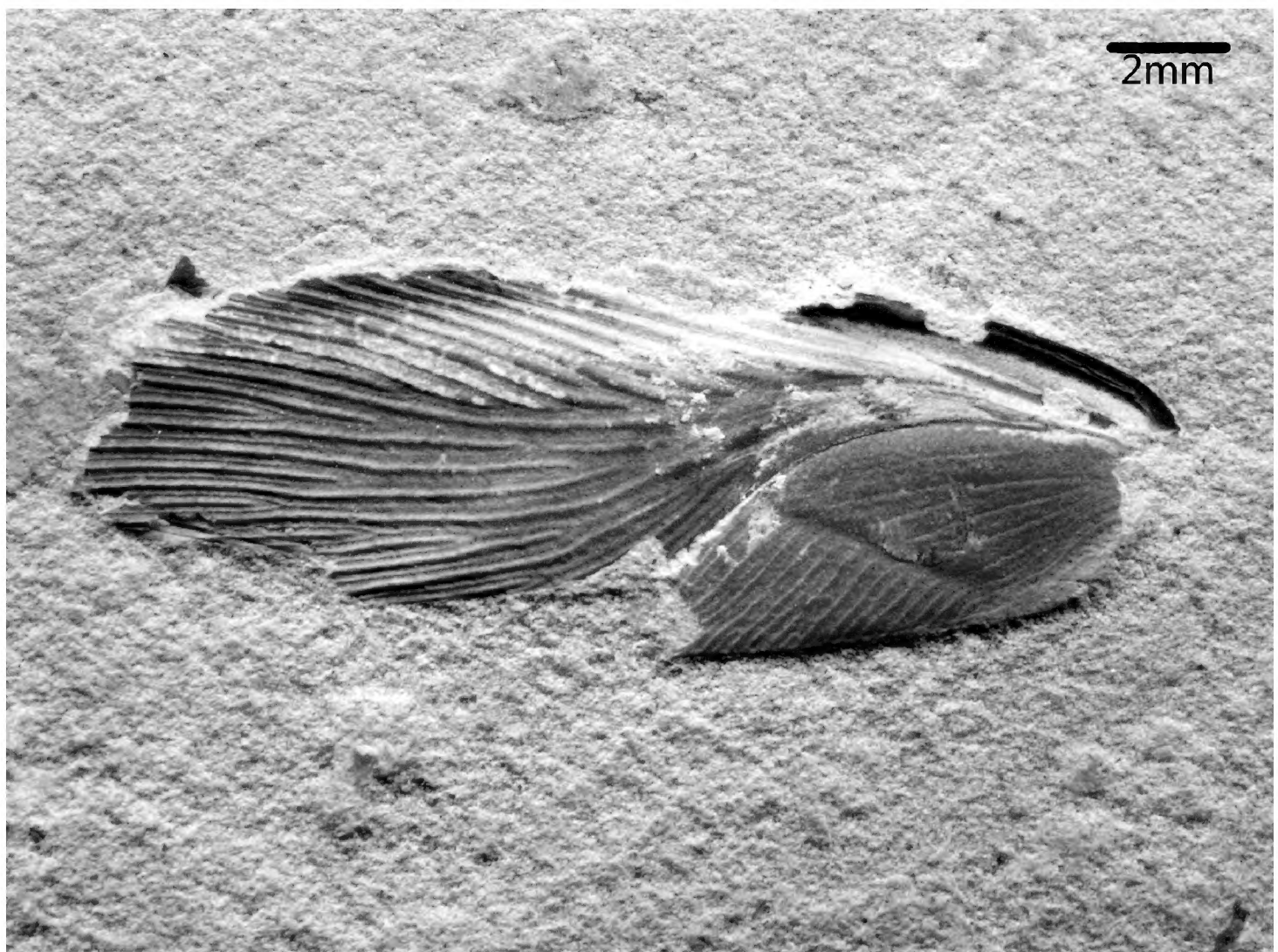
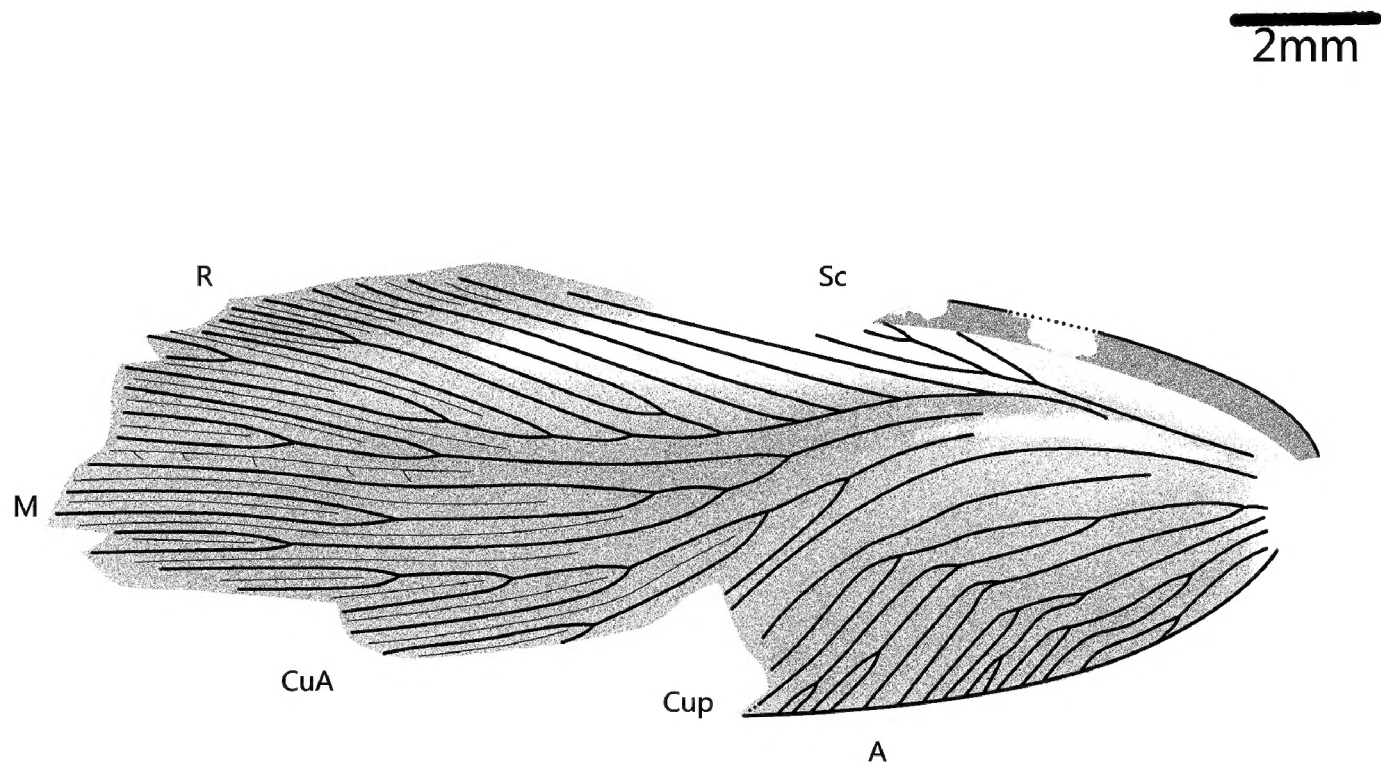
Figs 1–4

**Differential diagnosis.** Differs from *N. popovi* and *N. srneci* in having relatively small head, and antennal sockets conspicuous at sides, antennae long and thick; forewing

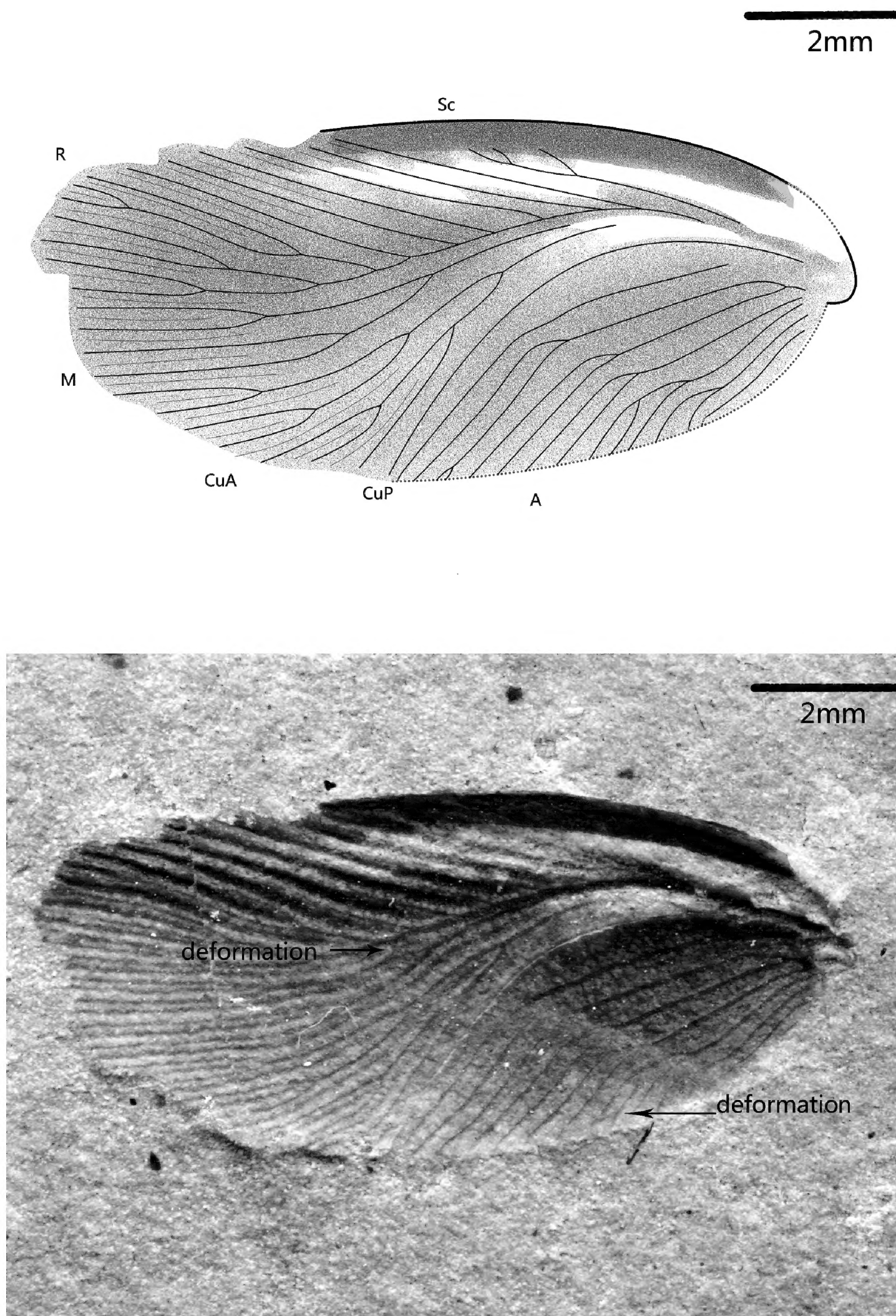


**Figure 1.** *Nuurcala obesa*, sp. n. Holotype, CNU-BLA-NN-2012055 **A** Line drawing **B** photograph. Scale bars = 5 mm.





**Figure 2.** *Nuurcala obesa*, *sp. n.* Paratype, CNU-BLA-NN-2012056 **A** Line drawing **B** photograph. Scale bars = 2 mm.



**Figure 3.** *Nuurcala obesa*, sp. n. Paratype, CNU-BLA-NN-2012057 **A** Line drawing **B** photograph. Scale bars = 2 mm.





**Figure 4.** *Nuurcala obesa*, *sp. n.* Paratype, CNU-BLA-NN-2012058; photograph. Scale bar = 2 mm.

with dark colouration except for R area, a dark maculae present at the edge of Sc area; hindwing with dark colouration; Legs with dark colouration, femora thick, tarsus with five segments and a claw (Fig. 1).

**Description.** Holotype (Fig. 1): body medium to large size, length about 23.8 mm as preserved, total estimated length is 25.2 mm, and width 9.9 mm; Abdomen with 6–7 visible segments. head small, length 1.8 mm, and width 2.5 mm, antennal sockets conspicuous at sides. Pronotum, shield-like, vaulted, transversal, simple symmetrical zonal colouration at the margin, length 6.2 mm, width 6.9 mm. Forewings: length 22 mm, width 6 mm; one dark maculae present at the edge of Sc area, dark colouration with pale area in R; 55 veins at margin; intercalaries thick, all over wing surface; Sc 3 branches, shorter than clavus; R sigmoidal 15 branches, with undifferentiated Rs, reaching the anterior wing margin; M slightly curved with 9 branches, most posterior branches of M reaching wing apex; CuA slightly curved to posterior wing margin and 10 branches; CuP curved and simple; clavus long, more than a third of the wing's length; A with tertiary branches. Hind wing (17 mm long as preserved vs. 22 mm long for forewing) with branched Sc; both R1 and RS about 9 veins; M 4 branches; Cu ( $\pm 9$ ) with additional blind branches that may reticulate, fan-like pleating present visible on forewing. Legs with dark colouration, femora thick, about 2 times as long as tibia, tarsus with five segments and a claw, spines obscure.

Paratypes (Figs 2–4): only forewing preserved, length range about 11.5–19 mm, width range about 5.2–5.7 mm; 42–48 veins at margin; Sc 3–5 branches, R sigmoidal 12–15 branches, M slightly curved and 4–9 branches, CuA 7–10 branches.

**Materials.** Holotype, partially preserved specimen with both fore- and hind wings and a body, CNU-BLA-NN-2012055 (Fig. 1). Paratypes (three isolated forewings): CNU-BLA-NN-2012056 (Fig. 2), CNU-BLA-NN-2011057 (Fig. 3), CNU-BLA-NN-2011058 (Fig. 4).

**Type locality and horizon.** Yixian Formation; Early Cretaceous; Huangbanjigou, Chaomidian Village, near Beipiao City, Liaoning Province, China.

**Etymology.** The specific name is derived from the Latin word “obesus”, (meaning “fat”), refer to the relatively large abdomen.

## Discussion

We consider the present taxon belonging to the genus *Nuurcala* based on the following features: Body medium to large size, both wings have dark markings, and forewing with characteristic colouration pattern. The four specimens vary in size significantly (wing length from 11.5 to 22 mm), and the size range of this species supports that Caloblattinidae are highly variable in size (Vršanský 2000), which is different from the Blattulidae (Wang et al. 2007a, b).

*N. obesa* sp. n. is similar to *N. popovi* Vršanský, 2003 in the following aspects: head hypognathous, pronotum transverse ovoid, and forewing with distinct cubital space, rather wide, but differs from *N. popovi* Vršanský, 2003 by forewings with subparallel margins and characteristic markings (dark markings with pale area in R), Sc branched, R rich, M branched, Cu veins ending prior to the apex of the wing, A branched, CuA almost straight, and then curved to posterior wing margin, anal area wide.

*N. obesa* sp. n. differs from *N. srneci* Vršanský, 2008 by the latter having much bigger head and the veins less numerous than *N. obesa*. The new species differs from *Nuurcala* sp. (PCMAS) from Erdenyi Ula, Mongolia in having a bigger pronotum (in contrast to 5.8/6.2 mm; forewing length 21 mm).

The number of forewing veins in *N. obesa* sp. n. is differs from those of previously reported *N. popovi* and *N. srneci*. For comparison, the data are listed in Table 1. The total number of forewing veins of *N. obesa* (42–55 veins) is higher than that of *N. srneci* (about 44 veins), but much less than that of *N. popovi* (54–83 veins). The number of forewing M veins of *N. obesa* (4–9 veins) is lower than those in *N. popovi* (8–17 veins) and *N. srneci* (6–11). The differences of venation further justify the erection of *Nuurcala obesa* sp. n.

There are some taxa placed in other genera which show affinities to the *Nuurcala*. *N. obesa* sp. n. differs from *Rhipidoblattina hebeiensis* Hong, 1980 from the Middle Jurassic Jiulongshan Formation (Hong 1980) by the dark maculae at the edge of Sc area, different dark colouration position at forewing, and more A veins for the new species. The new species is closely similar to *Samaroblatta nitida* Lin, 1986, which



**Table 1.** Variability of number of veins in forewings for three species of *Nuurcala*.

Species	Number of veins in forewings					
	Sc	R	M	Cu	A	Total
<i>N. obesa</i>	1–3	12–15	4–9	8–10	14–19	42–55
<i>N. popovi</i>	3–5	16–25	8–17	12–17	15–21	54–83
<i>N. srneci</i>	±3	13–16	6–11	8–14	5–7	±44

has the same forewing type and the intercalaries, but differs in venation character and the dark maculae (Lin 1986). The veins of new species have more branches than *Samaroblatta rhypha* Lin, 1986 and *Summatiblatta colorata* Lin, 1986. The new species differs from *Soliblatta lampra* Lin, 1986 by the shape of forewing, the latter with a lance shaped forewing (Lin 1986). The new species differs from *Shartegoblattina colorata* Vršanský, 2005 from the Sharin-Gol in Mongolia by the characters as follows: the new species just has one dark maculae present at the edge of Sc area, but *S. colorata* Vršanský, 2005 with colouration dark along the fore margin, more pale in the distal part than the new species. The new species differs obviously from *Solemnia alexandri* Vršanský, 2008 from the Houtiyn-Hotgor Locality in Mongolia due to the latter forewings extremely elongated.

Yixian Formation is characterized by a high proportion of coloured species (Wang et al. 2007a, b, Wei et al. 2013). Dry habitats are rather characterized by monochromatic and pale cockroach individuals (Vršanský et al. 2009, Wei and Ren in press). The new taxon supports the notion that Yixian Formation was humid and moist.

The family Caloblattinidae, starting with its first occurrence in the Middle Triassic, was important in almost all known ecosystems and dominated from the earliest Jurassic up to the latest Early Cretaceous (Vršanský 2008b). It is enigmatic that the family Caloblattinidae was rare in the Yixian Formation. Only 4 species have been described so far (Ren et al. 1995, Hong 1983, and this study). This is in contrast to the fact that in nearly all Jurassic and Cretaceous localities, this family is dominant or co-dominant (Vršanský et al. 2002). The Cretaceous is the most dynamic period in the history of the order. The transition between the Jurassic and Cretaceous is characterised by the change in the dominant families, and by appearance of extant families in the fossil record. Caloblattinidae have been replaced by Blattellidae, Mesoblattinidae and, to a lesser extent, by Blattulidae as the dominant families (Vršanský et al. 2002). In the Yixian formation, Blattulidae were dominant, and their taxonomic analysis supports the Jurassic/Lower Cretaceous age (Wang et al. 2007a, b). During Upper Jurassic/Lower Cretaceous transition, Caloblattinidae are known mostly from the rich assemblages in Karatau, South Kazakhstan (Vishniakova 1968, 1973), and the less rich one in Argentina, Australia, Brazil, Burma, China, England, France, Germany, Greenland, Japan, Kazakhstan, Kirgizstan, Mongolia, Russia, Spain, Switzerland, and South Africa. Comparing climates of Yixian Formation and other regions, the warm and moist climate of Yixian Formation might have been more suitable for Blattulidae.

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